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Conceptualization of contamination using depth discrete monitoring of dynamic PCE conc. changes during pumping.

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PCE contamination in a fractured limestone aquifer at a former central dry cleaning facility has undergone pump and treat (P&T) remediation with re-infiltration for 10 years after partial source removal in the overburden. The pumping and re-infiltration has diverted the groundwater flow, and hence the transport of PCE, in the fractured limestone aquifer adding to the complexity. The objective of the investigations was to generate a conceptual model for the residual contamination in the limestone aquifer at the site for optimization of the remediation. The conceptual model is based on the understanding of flow and transport processes in fractured limestone and high resolution data on the PCE distribution and dynamic concentration changes under different pumping schemes. The high resolution data was interpreted by support of a calibrated 3D site specific fracture model.

The highest PCE concentrations were observed in the upper crushed Copenhagen limestone and the highly fractured Copenhagen limestone, with lower and decreasing concentrations with depth in the underlying Bryozoan limestone. Significant concentration increases were observed when remedial pumping and re-infiltration was discontinued (in one case from < 1 to > 250 µg/L PCE). The concentration changes in the near source area were very dynamic in the fractured Copenhagen limestone. The dynamic changes observed are most likely due to fast fracture flow and back-diffusion from the limestone matrix in areas with residual contamination. The crushed limestone responded more slowly compared to the fractured zone and pumping in the fractured limestone had limited impact on the crushed zone concentrations. In addition to visualization and interpretation of the PCE distribution, the 3D model was used to deduce the likely zones of origin for the observed PCE contamination, showing that the P&T system has little effect on the contamination in parts of these zones. The new conceptual understanding can be used to optimize the remediation.